

Chrysanthemum Production in Bangladesh: Significance the Insect Pests and Diseases Management: A Review

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Received : October 13, 2020

Revised : November 3, 2020

Accepted : November 24, 2020

Online : November 26, 2020

Abstract

Chrysanthemum is a floricultural, ornamental and medicinal plant with tremendous income cash crop which is cultivated chiefly in winter. The crop charity as nerve sedative, anti-oxidant, anti-inflammatory, anti-mutagenic, anti-microbial, anti-fungal, anti-angiogenic, anti-atherosclerosis and nematocidal goods. Chrysanthemum has been used for hundreds of years in manufacturing medicine. It is used to treat respiratory complications, high blood pressure, and hyperthyroidism and reduce inflammation. Leaves remedies for colds, headaches, bronchitis, rheumatism, and swellings. The plant has aesthetic significance as well. Nevertheless, outbreaks of pests and diseases have hold back Chrysanthemum cultivation in Bangladesh. Insect pest damages the plant directly by sucking cell sap and indirectly spread out of virus diseases as act of vector. Aphid resistance variety might be the effective tool for successful production of chrysanthemum plant. Sustainable crop disease management for Chrysanthemum needs a multitude of consideration of the impacts of management methods on economics, sociology and ecology by wholly understanding the mechanisms of crop disease epidemics and the functioning of normal agroecosystems. The findings of this study present clear insights into efforts that will encourage farmers to adopt effective and ecological methods of pest and disease management for successful chrysanthemum production in Bangladesh.

Keywords: bangladesh, chrysanthemum, cut flower, pests, management

1. INTRODUCTION

Chrysanthemum indicum, sometimes called mums or chrysanthus [1] is one of the most important marketable ornamental and flower plants [2] belonging to the family Compositae/ Asteraceae, sub-family Asteroideae, order Asterales, sub-class Asteridae, tribe Anthemideae. It is native to East Asia [3] and has been cultivated in garden for more than 2500 years [4]. Owing to its high medicinal, ornamental and floricultural value, it contributes a very large share of Horticultural GDP and world flower trade [5]–[8]. Besides, medicinal and economic importance, it has aesthetic importance as well, which add versatile beauty of a place. They often remain in good condition for two to three weeks depending on cultivars and varieties [9]. Chrysanthemums are sold as annuals at garden centers every fall. Mums are actually perennials and will bloom for years if planted correctly. The plant

is a perennial aromatic flavor, with erect hairy stem, complete shiny leaves, highly cleft from the base, 70-120 cm height and heavily branched [10][11]. The leaves are oblong, typically 2 pinnatisect, yellow florets and it has big capitula, usually bicolored white and yellow which are used to treat inflammation. The flowers are corymb with yellow tubular structure [10][12]. The *C. indicum* flower is a good source of usual quercitrin and myricetin, which is important for the development of possible pharmaceuticals [13]. The variation showed by the large number of cultivars in deference of growth habit, size, color and shape of blooms make them suitable for every purpose conceivable of a flower. It showed inhibitory action against rat lens aldose reductase and against nitric oxide making in lipopolysaccharide started macrophages [14][15]. Good quality flower production relies on numerous factors such as genotype, insect resistance, environment, soil nutrient, spacing, disbudding, pinching, substrate, use of growth regulator etc. [16][17]. For profitable cultivation, quality flower production is important [18]. The erect and tall rising cultivars are suitable for background planting in edges or for use as cut flowers. However, the cultivars with the dwarf and compact growing habit are appropriate for front row farmstead or pot culture. The pod culture is important in the flower production of chry-

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Journal of Multidisciplinary Applied Natural Science

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santhemum [19]. Dwarf varieties easily fit the size of pot and looks adjusted from outside. The decorative and fluffy bloomed cultivars are ideal for garland making and hair decoration. The extra-large bloomed cultivars are prized for their display value. Though the flower yield and quality are primarily varietal characters, they are also greatly influenced by climatic factors. The successful cultivation of this plant is principally due to the great diversity of cultivars [20]. Different transform plants are grown in Bangladesh. A numerous number of chrysanthemum cultivars are found in Bangladesh. Jamal Uddin, et al. [21] observed that the 32 chrysanthemum cultivars coded from V1 to V32 were used for a study in Bangladesh. The cut blooms are also used in cemeteries in Japan [22]. Most of them are flowered in winter season. Genetic variation for flower yield and its component attributes were not properly studied in the past.

The leaves of this herb are edible and flowers have a pleasant smell. A condition for good quality cut flowers is that numerous flowers should be borne on long stems with healthy insect and disease-free foliage. It has ornamental value and many pharmaceutical firms dependent on several plants for medicine in the Western world. The pharmacopoeias have developed from ancient herbs. The leaf decoction is popularly used for the treatment of colds, headache, bronchitis, rheumatism, swellings and boils [23] as the leaf contents are enriched with anti-bacterial properties. Chrysanthemum is highly aromatic due to several volatile compounds of their essential oils, many of which are used in the flavor and fragrance purposes. The flower heads of *C. indicum* are sometimes used as chamomile adulterants. According to Jaime [24] the leaves are used for suppression of suspicious odors in foods such as soup, yuzu or pepper in Japan. It is available in

tropical and subtropical zones [25] and widely distributed in the Mediterranean region, Japan, China and the Philippines [26]. The diploid and tetraploid taxa of the Chrysanthemum are distributed mainly in Mediterranean region and Europe [27]. The spatiosum variety used as Chinese vegetable and others part of the plant are also used for treating different diseases. The bark is purgative and also to treat syphilis. It is rummage-sale against constipation, stomach parasitic contagions and real in the fight against nematodes and protects plants against caterpillars. The extract of *C. indicum* showed strong and selective allelopathic activity [27]. The flowers are stomachic, insecticidal and well known for its use against skin allergies like hives [28]. In spite of being a prospective crop, high occurrence of insect pests, and diseases are one of the main factors for the reduction of the yield and quality flower of *C. indicum* plant. Considering all these facts this study has been undertaken to certify the barriers and properties *C. indicum* crop plant. Keeping the threats of insect pests and diseases infestation of Chrysanthemums in a view point, this paper makes an attempt to assess the management techniques of the pests through different means that are feasible to adopt by the growers. The general objective is to assess the severe insect pests and diseases of the plants, extent of damages, and the management approaches. Also, the medicinal and esthetic significance of the plant has been highlighted.

2. CHRYSANTHEMUM CULTIVAR

Table 1 listed the popularly cultivated cultivars of Chrysanthemum in Bangladesh. Due to the favorable environmental conditions and an increased demand for flowers, a large number of different cultivars have high potential to be cultivated in dif-

Table 1. Different cultivars of Chrysanthemum in Bangladesh

Cultivars of Chrysanthemum			
(1) Kanchil	(7) Sabdhawna	(13) Shukla	(19) Beauty
(2) Glumohr	(8) Flirt	(14) Puspa Anmol	(20) Jubilee
(3) Shayamal	(9) Neelima	(15) Yellow Bangla	(21) Maghi Orange
(4) Sadwin Yellow	(10) White prolific	(16) Sharad Mala	(22) Maghi White
(5) White Andaman	(11) Ravikiran	(17) Star white	(23) Calvin Orange
(6) Aparjita	(12) Birbal Sahni	(18) Waters May	(24) Maghi yellow

Source: Kumar et al. [29]

ferent regions. Some of the cultivars are shown in Table 1.

3. INSECT PESTS OF CHRYSANTHEMUM CROP

The *C. indicum* plant is popular for possessing medicinal values however; its production is low due to the attack of a number of harmful sucking pests. Most cultivars are sensitive to aphids and infiltrations can lower quality and cause transmission of viruses' fiend out [30]. Visser, et al. [31] stated that a critical problem in chrysanthemum cultivation is outbreak of various insects such as aphids and others insect thrips (*Frankliniella occidentalis* Pergande) and spider mites (*Tetranychus urticae* Koch) on vegetative flowering and others parts of chrysanthemum. According to Teixeira da Silva, et al. [32] chrysanthemum is vulnerable to several insects and sucking pests which affect both the production and quality of the flowers at different growth stages. During the seedling stage, *Spodoptera litura* inhibits the growth of young plants. With growth of plants, infestation of sucking pests, mainly aphids, will be more. Chrysanthemum is affected by two aphids mainly chrysanthemum aphid and cotton aphid. Grasshoppers, thrips and spider mites are minor pests feeding on the plant specially flowers and leaves. The usually affect flower bud opening. The infestation continues even at full blooming stage. Aphids effect on these striking plants by sucking from the phloem of the vascular bundles of early shoots and leaves [33]. Plant parts affected by aphids will wilt, discolor or deform [34]. Aphids are regularly found in groups on plant tips, shoots of new growth or flowers. They multiply so fast on favorable conditions that a light infestation may increase to alarming proportions in a week. Some of the major aphids which severely infest *C. indicum* are briefly described below:

3.1. Cotton aphid (*Aphis gossypii* Glover, 1877)

The aphid is highly variable in color even within the same colony, ranging from light yellow to dark green, with dark Siphunculi and a pale or dusky. It is small to medium-sized, body length in apterous 1.05-1.90 mm, in alate 1.05-1.77 mm; This species is polyphagous and very threatening to many economically important plants [35] recorded this spe-

cies infested *Chrysanthemum* sp. in Baghdad, the infection was linked with *M. sanborni*. *A. gossypii* as the most dominant species of chrysanthemum plant [34].

3.2. Black bean aphid (*Aphis fabae* Scopoli, 1763)

The aphid is dull greenish black to black. It is small to medium-sized, body length in apterous 1.60-2.25 mm, in alate 1.80-2.6 mm; originated on young leaves, stems and inflorescences of many plants, mainly Leguminosae, Chenopodiaceae and Compositae [36].

3.3. Chrysanthemum aphid (*Coloradoa rufomaculata* Wilson, 1908)

The green aphid is small, body length in apterous 1.0-1.5 mm, in alate 0.9-1.5 mm; sometimes with yellow spots at Siphunculi base; found on the stem and underside of leaves of *Chrysanthemum* sp. This aphid species was presented as a new record for Iraq aphid fauna [34].

3.4. Chrysanthemum aphid (*Macrosiphoneilla sanborni* Gillette, 1908)

The shiny, dark red-brown to blackish brown, broadly spindle shaped, with black, relatively short and thick is Siphunculi. It is small to medium sized, body length in apterous 1.40-2.20 mm, in alate 1.40-2.30 mm. The members of this species are found on young stems and bases of leaves of *Chrysanthemum* sp. [37] are the authors who noted this aphid species in Iraq on *Chrysanthemum* sp.

3.5. Peach aphid (*Myzus persicae* Sulzer, 1776)

The peach is whitish green, pale yellowish green, greyish green, mid-green or pink, rather uniformly colored, not shiny. It is small to medium-sized, body length in apterous 1.65-2.35 mm, alate 1.90-2.45 mm, alate have a black central patch on the dorsal surface of the abdominal. According to Ali, et al. [34] the *M. persicae* is the lesser species in *Chrysanthemum* sp.

3.6. Insect Pests Management

In preliminary condition, it was observed that collection and destruction of the infested leaves, twigs, inflorescences and pod of the chrysanthemum crop that is mechanical control had good effects to manage the insect pests and the ladybird

beetle, spider and damselfly as found good predators of aphid. Neem leaf extract @ 1 kg Neem leaves: 10 L water and Dimethoate 40 EC @ 200 mL in 10 L water is suggested for one-acre land for controlling the aphid infestation. Botanical insecticides Neem leaf extract reduced the aphid population significantly on twigs, inflorescences and pods compared to untreated plants. In severe condition, application of insecticides was sprayed two times at seven days interval. Dimethoate 40EC, Carbosulfan 20 EC @ 2ml / L, Malathion-57 EC @ 0.2% and imidacloprid 200 sl @ 0.25mL/L were used for controlling Aphid successfully [38].

4. DISEASES OF CHRYSANTHEMUM CROP

The chrysanthemum flower crop is sensitive to some diseases that decline the medicinal quality. The viruses belonging to the family Bunyaviridae, genus Tospo virus including tomato spotted wilt virus (TSWV) and impatiens necrotic spot virus (INSV) are very serious pathogens not only on chrysanthemum plants but also on other horticultural plants [39][40]. These viruses cause severe systemic necrosis on plants and a lethal effect in the worst cases. Moreover, these viruses are easily transmitted by a small insect to a wide range of plant species belonging to over 50 plant families. This causes difficulty in preventing commercial products from the infection by these pathogens.

According to Ikten, et al. [41] the *C. indicum* phytoplasma cell wall less bacteria is related with diseases in several hundred plant species. Viroid is the smallest infectious agent that causes serious diseases in vegetative propagated plant including chrysanthemum [42]. *C. indicum* stunt viroid (CSVd) is a serious pathogen in the chrysanthemum production industry, because it is easily transmitted mechanically during the course of propagation. The only effective approach to protect plants against its infection is to strictly monitor this pathogen. The CSVd infection causes symptoms such as decrease of plant height, which lowers the commercial value of cut flowers. There are three types of viruses of flower plant based on environment, ecology and phytosanitary consideration [43] and the first class includes viruses that have wide host ranges, usually have efficient vectors and already widespread in world wide.

4.1. Virus

Virus diseases in Chrysanthemum were not recognized prior to 1945. Chrysanthemum stunt was first reported to be a virus problem in 1947 [44]. By 1949, it became a widespread and serious threat to the chrysanthemum field. The chrysanthemum stunt as a disease caused by a viroid (ChSV) [45]. By 1950, other virus pathogens were discovered that caused problems in chrysanthemum production. Nowadays, virus has been seen to be a serious problem in chrysanthemum cultivation in agroecosystem in Bangladesh.

Roughing out of infested plants, destroy crop residues from the field and removable of the host plant can manage virus existence. Resistant variety should be used for healthy cultivation of chrysanthemum. Controlled of Aphid by using Malathion-57 EC @ 0.2% can be achieved to control insect vectors. Foliar spray of imidacloprid 200 @ 0.25 mL/L of 7-11 days interval can be practiced.

4.2. Chrysanthemum rust

The white rust (*Puccinia horiana*) was first recorded in Japan in 1895 and then noted in China and Japan until the 1960s. In present time, fungal disease of rust is a serious disease in flower crop. Today it is established in Asia, Europe, Africa, Australia, Central America, South America and the Far East. It can spread quickly in natural and nursery environments, causing huge crop losses and reduction the flower quality. Toguri, et al. [46] stated from recent study that improved an Agrobacterium mediated transformation system in chrysanthemum and obtained more than 80 transgenic lines with pacl and also investigated tolerance of transgenic chrysanthemum plants expressing Pacl protein against CSVd and TSWV.

Removal of susceptible volunteer chrysanthemum plants, barberry plants and avoid excess N fertilizer in the field is necessary. Early maturity cultivars help to minimize the rust disease in chrysanthemum plants. Spraying propiconazole 25% EC @ 0.02% with 100L water at 15 days interval of 2-3 times is effective to manage the rust in this plant.

5. MEDICAL PROPERTIES OF CHRYSANTHEMUM

The chrysanthemum herb crop is a very im-

Table 2. Diversified uses of chrysanthemum crop

No.	Health Benefits of Chrysanthemum
1	Encourage effective metabolism in the body, which can help people to lose weight, bettered circulation, and improve neurotransmitter activity
2	Lower body temperature, and can help relieve the pain
3	Detoxify the liver, making body healthier overall, as well as make cholesterol numbers lower
4	Boost immune system because of its high level of Vitamin A and C
5	Check chronic illness, prevents cellular mutations, and protects body against several illness caused by free radicals
6	Help alleviate varicose veins
7	Rejuvenate the brain and alert the senses
8	Help ease digestive issues with fewer stomach problems
9	Improve bone density and prevent osteoporosis (due to presence of calcium and magnesium in plants)
10	Improve eyesight by alleviating dryness and itchiness in eyes
11	Treats cough and cold

portant medicinal plant and the whole plant parts are used for disease treatment. Many researchers investigated that the stems, leaves, and flowers of the plants are used as traditional medicine to treat vertigo, hypertensive symptoms, and several infectious diseases like pneumonia, colitis, stomatitis, carbuncle and fever [47]. Yet, systematic manipulation of these natural medicines for human health aids has not been carried out to a significant degree. In recent years, these basils have been the focus of care due to their medicinal and pharmacological values [48]. Plant products are widely used in pharmaceuticals, cosmetics and food trades. Many pharmaceutical companies in the Western world are contingent on many plants for their medicinal things. Pharmacopoeias have industrialized from ancient sages [49]. The extract of *C. indicum* the flowers were a flavone glucoside, acacetin 7-0-(3-0-acetyl- β -D-glucopyranoside) [50], has been isolated together with twenty-seven known compounds including flavonoids, caffeoylquinic acid derivatives, phenolics, and a monoterpenoid glucoside.

The medicinal plant native to China and Japan is *Chrysanthemum indicum* L. Its infusion is a remedy for intermittent fever, hysteria, and monthly irregularities. It is also used as carminative, tonic sedative, and for hypertension. Leaf decoction is a remedy for colds, headache, bronchitis, rheumatism, swellings and boils. The flower part is used as herbal medicine with strong aroma and many previous studies focused on its essential oil [13][51]–[53] which is prescribed for anti-inflammatory, analge-

sic, antipyretic purposes, quercetin, myricetin and the treatment of eye disease in Chinese traditional preparations. It demonstrated inhibitory action against rat lens aldose reductase and nitric oxide production in lipopolysaccharide activated macrophages. It has been used as the antioxidant, anti-inflammatory, anti-mutagenic, antimicrobial, anti-fungal, antiangiogenic, anti-atherosclerosis and nematocidal properties and the leaves are used as expectorant, bitter, and stomachic for the animal [54]. Hosni, et al. [55] observed that the volatile oil of wild chrysanthemums covers 22 components and the optimal extraction process is ethanol for 3 times, which can be achieved by adding 70% ethanol for 12 times. Some experts in the field of medicine have examined the pharmacological effect and chemical arrangement extraction methods of wild chrysanthemums medicinal herbs. Through the diagnosis of the claim in the clinical disease treatment, it can start that wild chrysanthemums have obvious pharmacological effect in clinical diseases and has certain application value. Xanthine oxidase (XO) is a key enzyme that catalyzes the oxidation of xanthine and hypoxanthine into uric acid [56], and plays a vital role in producing hyperuricemia and gout. Allopurinol is a clinically used XO inhibitor in the treatment of gout, which lumps the terminal step in uric acid biosynthesis and lowers the plasma uric acid concentration [57]. However, due to unwanted side effects of allopurinol, such as hepatitis, nephropathy, and allergic reactions, the search for new substitutes with increased therapeutic

tic activity and fewer side effects are necessary. In addition, superoxide anion radicals caused by XO are involved in various pathological states such as hepatitis, inflammation, ischemia reperfusion, carcinogenesis, and aging [58]. Thus, the search for novel XO inhibitors would be helpful not only to treat gout but also to combat numerous other diseases.

The *C. indicum* is one of the popular traditional medicines extensively used in Vietnam and indigenous to China. The flowers are used under the name "Cuc Hoa Trang" for the treatment of fever, rheumatism, inflammation, headache, and eyesight disorder [59]. Nguyen, et al. [60] had performed a study on these plants. In the course of their screening program for XO inhibitory medicinal plants from Vietnam, they screened 288 extracts, prepared from 96 medicinal plants used in Vietnamese traditional medicine to treat gout and related symptoms. Among them, the MeOH extract of the flowers of *C. indicum* showed the most potent XO inhibitory activity with an IC₅₀ value of 5.1 µg/mL [60]. Therefore, they carried out activity shown fractionation of the MeOH extract and isolated a new-fangled flavone glucoside, together with 14 known flavonoids, seven caffeoylquinic acid derivatives, five simple phenolics, and a monoterpenoid glucoside.

The *C. indicum* flowers have been prescribed for anti-inflammation, analgesic, and antipyretic purposes and the treatment of eye disease in Chinese traditional preparations. In the course of our characterization studies on the bioactive constituents from medicinal foodstuffs [60][61] and medicinal flowers [62] reported the isolation and structural elucidation of three eudesmane-type sesquiterpenes, kikkanols A, B, and C, and five germacrene-type sesquiterpenes, kikkanols D, D monoacetate, E, F, and F monoacetate, from the methanolic extract of the flowers of *C. indicum* cultivated in China [62]. In addition, the methanolic extract and several constituents were found to show inhibitory activities against rat lens aldose reductase [10] and nitric oxide (NO) production in lipopolysaccharide (LPS)-activated mouse peritoneal macrophages [63].

6. PROBLEMS FACED IN CHRYSANTHEMUM PRODUCTION

Changes are occurring throughout farming sector today, and these changes could majorly affect pest management. Pesticides are extensively used in plant cultivation. When compared to other types of controlling methods, pesticides can provide instantaneous pest knock-down impact with limited control, but rarely a long-lasting solution to the problems. Due to huge marketing approaches of the agrochemical companies, many farmers have grown accustomed to applying pesticides, often as preventive solution against disease injuries and crop loss. Chrysanthemum disease management faces ever-increasing problems due to: (i) rising demands for alternative plantations to support the burgeoning global population; (ii) declining production potential in agriculture because of more competition for land in fertile areas and exhaustion of marginal arable lands; (iii) worsening ecology of agroecosystems and depletion of natural resources; and (iv) increased hazard of disease epidemics resulting from agricultural intensification and monocultures. Fungicide resistance is an increasing menace to farmers. Most of the farmers lack sound knowledge on use of pesticides and other methods of disease control. Recommendations of the plant experts for use of appropriate dose of pesticides and fertilizers are not usually followed by the farmers. The problems lie in the lack of governmental and non-governmental support to develop the effective agricultural policies, integrated pest management approaches, and the best way of pest and disease control.

7. CONCLUSION

As an ornamental and medicinal purpose, it is authoritative to recognize the bio active combinations which are responsible for its pharmacological effects especially in the essential oil as medicine of human body of the plant but its production hamper due to attack of a number of aphids as insect, virus as diseases and planting material as verities. The production of Chrysanthemum earmark problem is its cutting collection as well as its quality planting material's availability. The insects and diseases resistance cultivar and simultaneously integrated pest management approaches are inevitable for successful cut flower production of *C. indicum*.

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ACKNOWLEDGEMENT

This work was supported by the parents of the authors, colleagues, and the related field expert's professors. The authors owe their sincere gratitude to the all helping hands that assisted during manuscript preparation.

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